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Lewis Research Center

Computer Program for Definition of Transonic Axial-Flow Compressor Blade Rows

A computer program for designing axial-flow compressor blading from stacked blade elements has been developed. The particular type of blade element used has two segments which have centerlines and surfaces described by constant change of angle with path distance on a cone. The program is the result of rework of an earlier program to give major gains in accuracy, reliability and speed. This program also covers more steps of the overall compressor design procedure.

The computer program begins with input from velocity diagrams for stations near the leading and trailing edges of the blade and parameters for blade-element description. The blade design steps are: (1) blade-element definition, (2) blade-element stacking, (3) interfacing the reference station velocity diagrams to the blade-element edges, and (4) terminal calculations. The first three parts are used in an iterative procedure to establish the blade for terminal calculations.

Blade-element angles are obtained from the velocity diagrams by (1) correcting the velocity diagrams from fixed locations to the edges of the blades through continuity and conservation of angular momentum principles as stacking adjustments move the blade edges, (2) determining and applying incidence and deviation angles at the edges of the blade with one of several common methods chosen through control options, and (3) correcting the inlet and outlet blade-edge angles on a streamline of revolution to the blade-element layout cone with the use of appropriate direction derivatives.

The iterative stacking adjustments are made by translating the blade elements along the cone so that the center of area of the associated blade section is alined on the stacking axis. The stacking axis through input controls can be leaned in either the axial or tangential directions.

The output of the computer program gives coordinates for fabrication and properties for aeroelastic analysis on planar blade sections. These coordinates and properties are defined by interpolation across conical blade elements to planes perpendicular to a radial line through the hub stacking point. The output blade-section properties are area, center-of-area location, stacking-point location, maximum and minimum moments of inertia along with their orientation, torsion constant, and twist stiffness.

Notes:

1. The program is written in FORTRAN IV for use on either an IBM 7090/7094 or an IBM 360-67 computer.
2. The program is set up with output options to give the fabrication coordinates on punched cards and on microfilm. Since the system microfilm subroutines will not be applicable to another computer, instructions are given to help in the conversion to another facility.
3. The computer program presented is internally structured for use as a part of a composite compressor design program. But, in the form presented, the program is set up to run as a separate entity so that it can be used in conjunction with different aerodynamic design programs.
4. This program supersedes a previous program, LEW-11059, "A Computer Program for Composing Compressor Blading from Simulated Circular-Arc Elements on Conical Surfaces," by Crouse, Janetzke, and Schwirian.
5. Inquiries concerning this program should be directed to:

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